Cavernous Redirection of Venous Drainage after Partial Transvenous Coil Occlusion of a Sigmoid Sinus dAVF: Coil Mass Retrieval with Flexible Cysto-Urethroscopy Grasping Forceps

A Technical Note

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Summary

We describe the case of a patient who presented with ocular symptoms (chemosis, proptosis, increased intra-ocular pressure, impaired visual acuity) eight months after the transvenous coil occlusion of an ipsilateral sigmoid sinus dural arteriovenous fistula (dAVF).

Digital substraction angiography revealed a partial occlusion of the left sigmoid sinus with coils. Since the connection from the sigmoid sinus to the internal jugular vein was obliterated by coils without interrupting the arteriovenous shunt, the venous drainage was redirected into the inferior petrosal sinus, the cavernous sinus and the superior ophthalmic vein.

The transjugular access to the inferior petrosal sinus was obstructed by a large coil mass in the jugular bulb. Several attempts to remove these coils with an Alligator retrieval device and a goose neck snare failed.

The coil mass was withdrawn via a direct access to the internal jugular vein using flexible cysto-urethroscopy grasping forceps, an urological device designed for the removal of kidney stones. After establishing anterograde drainage, the now accessible inferior petrosal sinus was occluded with fibered coils and the dAVF was completely obliterated. The ocular symptoms resolved within ten days.

Introduction

Dural arteriovenous fistulas (dAVF) of the transverse and sigmoid sinus may cause pulsatile tinnitus, increased intracranial pressure and cerebral hemorrhage. Endovascular treatment has largely replaced surgical concepts. In addition to transarterial embolization of feeding arteries [1], transvenous coil occlusion of sinus segments and compartments [2], transvenous stent deployment [3] and balloon-protected transarterial injection of Onyx [4] have become widely accepted variants of endovascular treatment. Worsening of the type of venous drainage of dAVFs is an infrequently encountered and underreported phenomenon, which may follow incomplete endovascular occlusion [5]. If a liquid embolic agent or a stent has been used, direct impact on the venous drainage is the only viable option since glue or large stents can hardly be withdrawn. In the case of issues related to previously inserted coils, removal of these coils may be attempted. The established neurovascular tools for this purpose are snares and microforceps [6-8]. These devices, however, are designed for use in small caliber intracranial arteries. They are generally not well suited for the removal of large coil masses. Here we report a case of a partially coil-occluded sigmoid sinus dAVF with a symptomatic diversion of the ve-

nous drainage into the ipsilateral inferior petrosal and cavernous sinus. The treatment required a transvenous removal of a large coil mass from the internal jugular vein, which was finally accomplished with a flexible macroforceps designed for urological endoscopy.

Case Report

A 65-year-old woman was treated in another hospital for a left sigmoid sinus dAVF, symptomatic with a pulsatile tinnitus. Arterial supply came from the ascending pharyngeal, retro-auricular, occipital, posterior meningeal arteries, and from muscular branches of the left vertebral artery. The left sigmoid sinus and internal jugular vein were fully patent and drained the dAVF. The left inferior petrosal and cavernous sinus did not participate in the drainage of the dAVF. A transarterial coil occlusion of the left occipital artery and muscular branches from the left vertebral artery did not improve the clinical symptoms. In January 2009, a transvenous coil occlusion of the left sigmoid sinus and jugular bulb was performed elsewhere and the tinnitus had ceased completely. Eight months after this treatment, the patient presented with chemosis, proptosis, increased intraocular pressure and impaired visual acuity of her left eye. MRI showed a significant enlargement of the left superior ophthalmic vein.

Angiography with injection of the left VA revealed a residual arteriovenous shunt at the left sigmoid sinus with feeding arteries from the left posterior meningeal artery. The venous drainage was obstructed by coils in the sigmoid sinus and jugular bulb and was from there diverted into the left inferior petrosal sinus, the left cavernous sinus and the left superior ophthalmic vein (Figure 1).

During the first treatment session, the attempts to catheterize the left inferior petrosal sinus either directly or via the right inferior petrosal sinus and the intercavernous sinus failed. In order to reduce the retrograde venous drainage into the inferior petrosal sinus and redirect the drainage caudally, a transvenous removal of coils located in the jugular bulb was contemplated. Attempts with an Alligator retrieval device (ev3) and with a 4 mm goose neck snare (ev3) were not successful, probably due to the dense compaction of the coils. After these failed attempts, the left internal jugular vein was punctured in retrograde direction and an 8F sheath was inserted. Flexible 7F/40 cm grasping forceps for cysto-urethroscopy was inserted (Karl Storz, Tuttlingen, Germany, Reference Number FK 27034). This is a forceps for urological endoscopy (Figure 2). This device allowed the fast and well-controlled removal of the coils from the left jugular bulb. Subsequent to this maneuver, flow into the left inferior petrosal sinus was reduced and the left cavernous sinus and the superior ophthalmic vein were no longer opacified (Figure 3). The ocular symptoms disappeared completely within ten days. The tinnitus, however, which had ceased before recurred at the full previous extent. During a second treatment session, 30 days later, the arterial feeders of the dAVF from the posterior meningeal artery were catheterized with a Echelon-10 45º microcatheter (ev3) and a Traxcess14 guidewire (Microvention), and were subsequently embolizated with Glubran2/Lipiodol 1:4 (0.3 cc). This arterial embolization was performed as an adjunct to the transvenous coil occlusion of the inferior petrosal sinus, the sigmoid sinus and the jugular bulb with bioactive coils.

The final series of the left vertebral artery and the left external carotid artery confirmed a total obliteration of the dAVF (Figure 4). Both therapeutic procedures were carried out under general anesthesia and were well-tolerated. Six-month follow-up angiography showed a persistent obliteration of the dAVF. The patient remained asymptomatic with complete resolution of both the ocular symptoms and her tinnitus.

Discussion

Intracranial dAVFs are acquired arteriovenous shunts inside the dura that represent 10-15% of all intracranial vascular malformations. Although dAVFs can occur anywhere within the dura mater, the most frequent locations are the transverse–sigmoid sinus and the cavernous sinus [9].

Patients may be asymptomatic or may experience symptoms ranging from tinnitus to fatal hemorrhage. It is generally accepted that the venous drainage pattern of dAVFs is the major predictive factor for their risk profile. dAVFs with retrograde cortical venous flow (leptomeningeal reflux) frequently cause intracranial hypertension and cerebral hemorrhage [10,11]. Changes in the venous drainage pattern may cause modifications of the neurological symptoms. Symptoms of intracranial hypertension

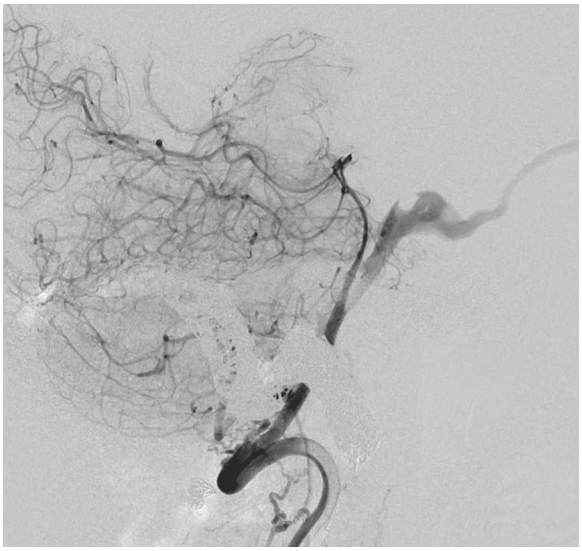
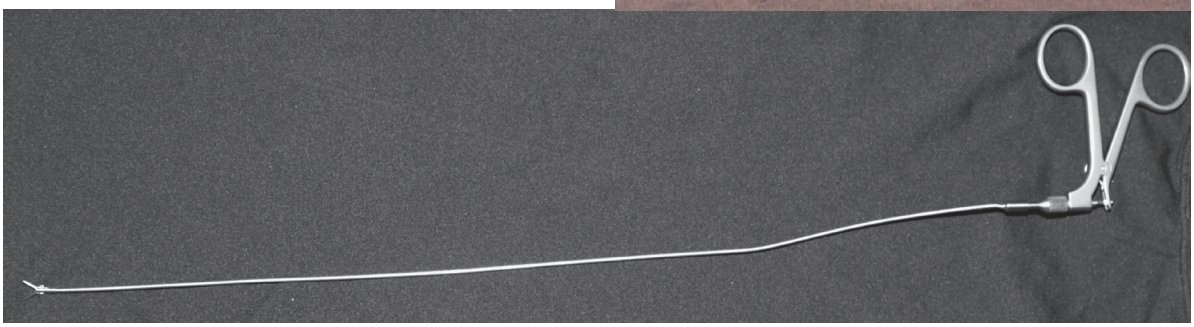


Figure 1 dAVF of the left sigmoid sinus 8 months after transvenous coil occlusion of the sinus. The arteriovenous shunt is not completely interrupted. Since a large coil mass is obliterating the connection between the sigmoid sinus and the internal jugular vein, the venous drainage is redirected towards to inferior petrosal sinus, the cavernous sinus and the superior ophthalmic vein.

Figure 2 Flexible grasping forceps for cysto-urethroscopy (Karl Storz, Tuttlingen, Germany, Reference Number FK 27034).

A



B

have often been described in dAVF patients. Intracranial hypertension may be secondary to a compromised venous drainage or due to an anomaly of the sinus distal to the fistula [12]. Treatment of a sigmoid sinus dAVF is indicated and the endovascular approach is the first choice for the majority of patients. Although the endovascular treatment can be accomplished via a transarterial and/or transvenous approach, retrograde transvenous occlusion of the diseased sinus with coils was considered to be a less invasive and more effective method of treatment.

The transvenous coil occlusion of transverse/sigmoid sinus dAVFs can mostly be performed with a high level of safety and efficacy [13]. Reported complications are related to arterial embolizations and include cranial nerve palsies, ischemic stroke and intracranial hemorrhage. Inadvertent partial occlusion may be related to loose coil packing or, may have its source in parallel dural channels within the affected sinus [14]. Although the *de novo* formation of a remote dAVF after endovascular embolization of another dAVF has been described [15], redirection of the venous drainage is an underreported complication of the endovascular treatment of dAVFs. Diversion of the venous drainage, either spontaneously or as a result of the treatment, may change the nature and symptoms of

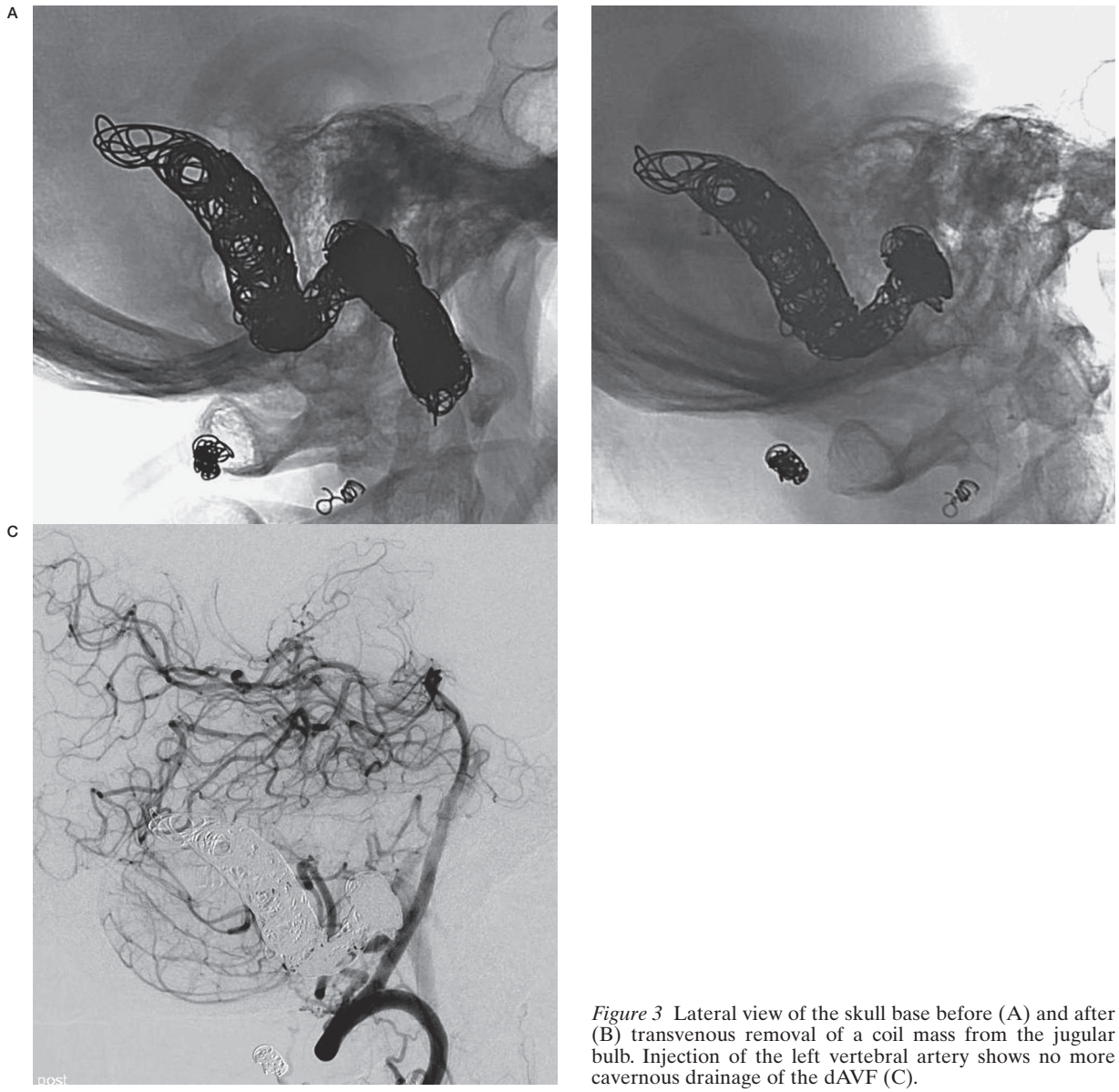


Figure 3 Lateral view of the skull base before (A) and after (B) transvenous removal of a coil mass from the jugular bulb. Injection of the left vertebral artery shows no more cavernous drainage of the dAVF (C).

such a fistula and redirection of the venous drainage into cortical veins carries a risk of subsequent intracranial hemorrhage. If, as was the case in the patient presented here, access to the draining veins is prevented by previously implanted coils, the management of this situation can be very challenging.

Various strategies to remove displaced coils during endovascular procedures have been reported, including surgery [16], and several endovascular devices have been developed to retrieve foreign bodies from the cerebral circulation [7,8].

However, these tools are designed for use in small caliber intracranial arteries and are generally just too weak to handle large coil masses or stents. With the above described flexible endoscopic macroforceps, borrowed from the urological clinic, transvenous retrieval of dozens of coils was achieved in a short time, avoiding more invasive efforts (e.g., surgical "coilectomy").

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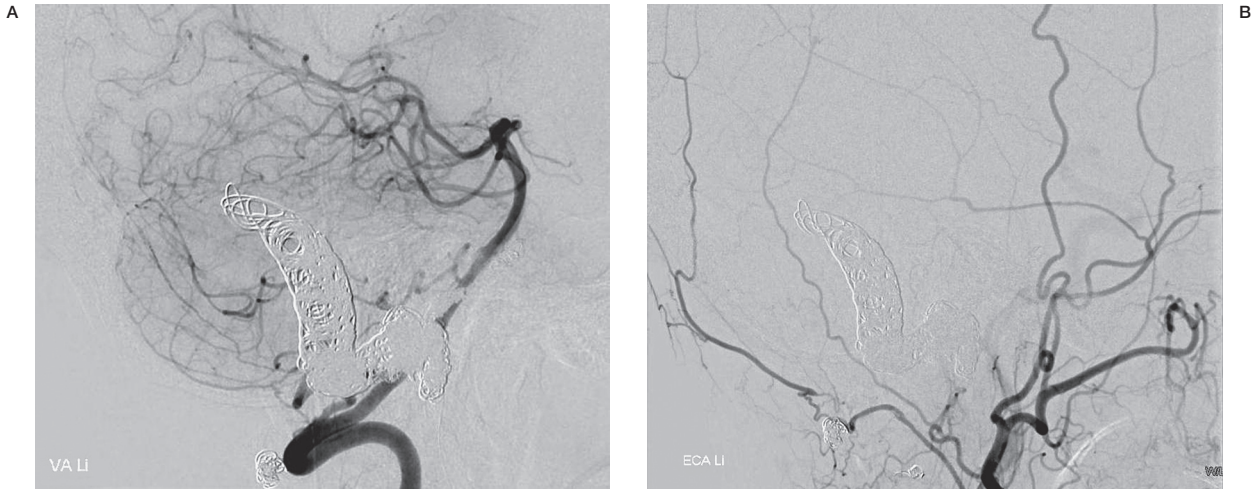

Figure 4 Injection of the left vertebral artery (A) and the left external carotid artery (B) confirms the complete interruption of the dural arteriovenous shunt after re-occlusion of the sigmoid and inferior petrosal sinus with fibered coils and transarterial embolization.

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